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NOTICE OF ALLOWANCE AND FEE(S) DUE

22879 7590 12/02/2010

HEWLETT-PACKARD COMPANY
Intellectual Property Administration
3404 E. Harmony Road
Mail Stop 35
FORT COLLINS, CO 80528

EXAMINER

CHEN, QING

ART UNIT

PAPER NUMBER

2191

DATE MAILED: 12/02/2010

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/676,557	10/01/2003	David E. Lowell	200208633-1	7663

TITLE OF INVENTION: INTERPOSING A VIRTUAL MACHINE MONITOR AND DEVIRTUALIZING COMPUTER HARDWARE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	03/02/2011

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. **PROSECUTION ON THE MERITS IS CLOSED.** THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN **THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE** OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. **THIS STATUTORY PERIOD CANNOT BE EXTENDED.** SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

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Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

22879 7590 12/02/2010

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nonprovisional	NO	\$1510	\$300	\$0	\$1810	03/02/2011

EXAMINER	ART UNIT	CLASS-SUBCLASS
CHEN, QING	2191	717-120000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a **Customer Number is required.**

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____
 (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____
 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY AND STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____
 Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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22879	7590	12/02/2010	EXAMINER	
HEWLETT-PACKARD COMPANY Intellectual Property Administration 3404 E. Harmony Road Mail Stop 35 FORT COLLINS, CO 80528			CHEN, QING	
			ART UNIT	PAPER NUMBER
			2191	
			DATE MAILED: 12/02/2010	

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 710 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 710 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability

Application No.

10/676,557

Examiner

Qing Chen

Applicant(s)

LOWELL ET AL.

Art Unit

2191

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the amendment filed on August 13, 2010.
2. ☒ The allowed claim(s) is/are 1,5-18,21-25,28,29,31-40,43-47,49-56,58-60 and 63-72, renumbered as 1-58.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: ____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date ____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date ____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date ____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413),
Paper No./Mail Date ____
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other ____.

DETAILED ACTION

1. This Office action is in response to the amendment filed on August 13, 2010.
2. **Claims 1, 5-18, 21-25, 28, 29, 31-40, 43-47, 49-56, 58-60, and 63-72** are pending.
3. **Claims 1, 5, 6, 10, 12-16, 21-25, 28, 29, 31, 32, 35-40, 43-46, 49, 50, 52, 53, 55, 56, 58-60, and 63-72** have been amended.
4. **Claims 2-4, 19, 20, 26, 27, 30, 41, 42, 48, 57, 61, 62, 73, and 74** have been canceled.
5. **Claims 1, 5-18, 21-25, 28, 29, 31-40, 43-47, 49-56, 58-60, and 63-72** are allowed, renumbered as 1-58.
6. The objections to Claims 6, 21, 32, and 68 are withdrawn in view of Applicant's amendments to the claims.
7. The provisional nonstatutory obviousness-type double patenting rejections of Claims 41 and 62 over copending Application Nos. 10/676,922 and 10/677,159 are withdrawn in view of Applicant's amendments to the claims of the copending applications and/or Examiner's amendments to the claims of the instant application.
8. The 35 U.S.C. § 112, second paragraph, rejections of Claims 29 and 58 are withdrawn in view of Applicant's amendments to the claims.

Examiner's Amendment

9. An Examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to Applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this Examiner's amendment was given in a telephone interview with Dan C. Hu (Reg. No. 40,025) on November 19, 2010.

The application has been amended as follows:

AMENDMENTS TO THE SPECIFICATION

Please amend the title as follows:

INTERPOSING A VIRTUAL MACHINE MONITOR AND DEVIRTUALIZING
COMPUTER HARDWARE AT RUNTIME

AMENDMENTS TO THE CLAIMS

In the "Amendments to the Claims" (received on 08/13/2010), please cancel Claims 3, 4, 19, 20, 26, 27, 30, 41, 42, 61, 62, 73, and 74 and amend Claims 1, 5, 6, 10, 12-16, 21-25, 28, 29, 31, 32, 35-40, 43-46, 49, 50, 52, 53, 55, 56, 58-60, and 63-72 as follows:

1. (Currently Amended) A method of using a virtual machine monitor and an operating system on computer hardware in a computer, the method comprising:

booting the operating system on the computer hardware such that the operating system has direct control of at least a portion of the computer hardware including a central processing unit (CPU), a physical memory, and an input/output (I/O) device;

interposing the virtual machine monitor between the computer hardware and the operating system at runtime, wherein runtime includes a period of execution in the computer after booting and before shutdown of the computer, wherein the interposing occurs after booting of the computer, and wherein interposing the virtual machine monitor gives the virtual machine monitor direct control of the at least a portion of the computer hardware such that the operating system no longer has direct control of the at least a portion of the computer hardware; and

~~booting the operating system on the computer hardware before interposing the virtual machine monitor at runtime~~

devirtualizing the at least a portion of the computer hardware at runtime after the virtual machine monitor has been interposed at runtime, wherein devirtualizing the at least a portion of the computer hardware comprises stopping the virtual machine monitor such that the operating system resumes having direct control of the at least a portion of the computer hardware.

3. (Canceled)

4. (Canceled)

5. (Currently Amended) The method of claim 1, ~~wherein the computer hardware includes a CPU;~~ and wherein the virtual machine monitor is interposed on the CPU.

6. (Currently Amended) The method of claim 5, wherein ~~the computer hardware further includes memory, and~~ the virtual machine monitor and the operating system each include CPU interrupt handlers; and wherein interposing the virtual machine monitor on the CPU includes:

causing privileged instructions to trap to the virtual machine monitor, and
redirecting interrupts to the corresponding virtual machine monitor CPU interrupt handlers
instead of to the operating system CPU interrupt handlers.

10. (Currently Amended) The method of claim 6, wherein interposing the virtual machine monitor on the CPU further includes loading the virtual machine monitor into the physical memory.

12. (Currently Amended) The method of claim 5, ~~wherein the computer hardware includes memory, and~~ wherein the virtual machine monitor is also interposed on the physical memory.

13. (Currently Amended) The method of claim 12, wherein interposing the virtual machine monitor on the physical memory includes partitioning the physical memory to provide partitions, and giving the virtual machine monitor access to at least one of the partitions.

14. (Currently Amended) The method of claim 12, wherein interposing the virtual machine monitor on the physical memory includes using a kernel module of the operating system

to allocate a block of the physical memory, pin the block to prevent the operating system from using the block, and allocate the pinned block to the virtual machine monitor.

15. (Currently Amended) The method of claim 12, wherein interposing the virtual machine monitor on the physical memory includes commencing using the virtual machine monitor at runtime to manage memory translation.

16. (Currently Amended) The method of claim 5, ~~wherein the computer hardware includes an I/O device, and~~ wherein the virtual machine monitor is also interposed on the I/O device.

19. (Canceled)

20. (Canceled)

21. (Currently Amended) The method of claim [[20]] 1, ~~wherein the virtualized computer hardware further includes physical memory, and~~ the virtual machine monitor and the operating system each include CPU interrupt handlers; and wherein devirtualizing the [[CPU]] at least a portion of the computer hardware includes redirecting interrupts to the corresponding operating system CPU interrupt handlers instead of to the virtual machine monitor CPU interrupt handlers.

22. (Currently Amended) The method of claim 21, wherein devirtualizing the [[CPU]] at least a portion of the computer hardware further includes restoring a privilege level of the operating system from a less privileged mode to a more privileged mode.

23. (Currently Amended) The method of claim 21, wherein devirtualizing the [[CPU]] at least a portion of the computer hardware further includes enabling ~~physical memory~~ access of the physical memory by the operating system.

24. (Currently Amended) The method of claim 21, wherein devirtualizing the [[CPU]] at least a portion of the computer hardware further includes unloading the virtual machine monitor from the physical memory.

25. (Currently Amended) The method of claim [[19]] 1, ~~wherein the virtualized computer hardware includes memory;~~ and wherein the physical memory is devirtualized at runtime.

26. (Canceled)

27. (Canceled)

28. (Currently Amended) The method of claim [[19]] 1, ~~wherein the virtualized computer hardware includes an I/O device;~~ and wherein the I/O device is devirtualized at runtime.

29. (Currently Amended) The method of claim [[28]] 1, wherein the operating system includes a dual-mode driver that performs direct hardware control in a first mode and communicates with a device driver of the virtual machine monitor in a second mode; and wherein devirtualizing the ~~I/O device~~ at least a portion of the computer hardware includes:

setting the dual-mode driver to the first mode from the second mode, and
redirecting I/O interrupts to handlers in the operating system instead of handlers in the virtual machine monitor.

30. (Canceled)

31. (Currently Amended) A computer comprising hardware, the hardware including a central processing unit (CPU), a physical memory, and an input/output (I/O) device, the physical memory encoded with an operating system, a virtual machine monitor, and code for interposing the virtual machine monitor between the operating system and the hardware at runtime, wherein runtime includes a period of execution in the computer after booting and before shutdown of the computer, and wherein the interposing occurs after booting of the computer,

wherein the operating system is to be booted [[in]] on the hardware such that the operating system has direct control of at least a portion of the hardware ~~computer~~ before interposing the virtual machine monitor, wherein interposing the virtual machine monitor gives the virtual machine monitor direct control of the at least a portion of the hardware such that the operating system no longer has direct control of the at least a portion of the hardware, and

wherein the physical memory is further encoded with code for devirtualizing the at least a portion of the hardware at runtime after the virtual machine monitor has been interposed at runtime, wherein devirtualizing the at least a portion of the hardware comprises stopping the virtual machine monitor such that the operating system resumes having direct control of the at least a portion of the hardware.

32. (Currently Amended) The computer of claim 31, ~~wherein the hardware further includes a CPU,~~ wherein the virtual machine monitor is interposed on the CPU at runtime, and the virtual machine monitor and the operating system each include CPU interrupt handlers; and wherein the interposing code is to cause privileged instructions to trap to the virtual machine monitor, and to redirect interrupts and traps to the corresponding virtual machine monitor CPU interrupt handlers instead of to the operating system CPU interrupt handlers.

35. (Currently Amended) The computer of claim 32, wherein the interposing code is to disable ~~physical memory~~ access to the physical memory by the operating system.

36. (Currently Amended) The computer of claim 31, wherein the interposing code includes a kernel module of the operating system for allocating a block of the physical memory, pinning the block to prevent the operating system from using the block, and allocating the pinned block to the virtual machine monitor, ~~whereby the virtual machine monitor is interposed on the memory at runtime.~~

37. (Currently Amended) The computer claim 31, wherein the interposing code is to commence using the virtual machine monitor at runtime to manage memory translation, ~~whereby the virtual machine monitor is interposed on the memory at runtime.~~

38. (Currently Amended) The computer of claim 31, ~~wherein the hardware further includes an I/O device; and~~ wherein the interposing code includes an operating system dual-mode driver to perform direct hardware control in a first mode and to communicate with a device driver of the virtual machine monitor in a second mode; and wherein the interposing code is to set the dual-mode driver to the second mode, and to direct I/O interrupts to interrupt handlers in the virtual machine monitor instead of to interrupt handlers in the operating system, ~~whereby the virtual machine monitor is interposed on the I/O device at runtime.~~

39. (Currently Amended) The computer of claim 31, ~~wherein the hardware further includes an I/O device; and~~ wherein the operating system includes a dual-mode driver to perform direct hardware control in a first mode and to communicate with a device driver of the virtual machine monitor in a second mode; and wherein the interposing code is to set the dual-mode driver to the second mode, and to redirect I/O interrupts to interrupt handlers in the virtual machine monitor instead of to interrupt handlers in the operating system, ~~whereby the virtual machine monitor is interposed on the I/O device.~~

40. (Currently Amended) The computer of claim 31, ~~wherein the hardware further includes an I/O device; and~~ wherein the interposing code is to commence I/O emulation of the

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I/O device at runtime, ~~whereby the virtual machine monitor is interposed on the I/O device at runtime.~~

41. (Canceled)

42. (Canceled)

43. (Currently Amended) The computer of claim [[42]] 31, wherein the ~~memory is further encoded with an~~ operating system ~~including~~ includes interrupt handlers; wherein the virtual machine monitor includes interrupt handlers; and wherein the devirtualizing code is to redirect interrupts to the corresponding interrupt handlers of the operating system instead of to the interrupt handlers of the virtual machine monitor.

44. (Currently Amended) The computer of claim 43, wherein the devirtualizing code is to restore a privilege level of the operating system from a lower privilege level to a higher privilege level.

45. (Currently Amended) The computer of claim 43, wherein the devirtualizing code is to enable ~~physical memory~~ access of the physical memory by the operating system.

46. (Currently Amended) The computer of claim [[41]] 31, wherein the devirtualizing code is to devirtualize the physical memory at runtime.

49. (Currently Amended) The computer of claim ~~[[41]]~~ 31, ~~wherein the hardware includes an I/O device, wherein the virtual machine monitor is to virtualize the I/O device; and wherein the devirtualizing code is to devirtualize the I/O device at runtime.~~

50. (Currently Amended) The computer of claim 49, wherein the ~~memory is further encoded with an~~ operating system ~~including~~ includes dual-mode drivers to perform direct hardware control in a first mode and communicate with device drivers of the virtual machine monitor in a second mode; and wherein the devirtualizing code is to set the dual-mode drivers to the first mode from the second mode, and to redirect I/O interrupts to handlers in the operating system instead of to handlers in the virtual machine monitor.

52. (Currently Amended) An article for use with an operating system on computer hardware, the article comprising a computer-readable storage medium storing software that when executed by ~~[[the]]~~ a computer causes the computer to:

boot the operating system on the computer hardware such that the operating system has direct control of at least a portion of the computer hardware including a central processing unit (CPU), a physical memory, and an input/output (I/O) device;

virtualize at least a portion of the computer hardware at runtime by providing interpose a virtual machine monitor between the operating system and the computer hardware at runtime, wherein runtime includes a period of execution in the computer after booting and before shutdown of the computer, wherein the virtualizing interposing occurs after booting of the

computer, and wherein interposing the virtual machine monitor gives the virtual machine monitor direct control of the at least a portion of the computer hardware such that the operating system no longer has direct control of the at least a portion of the computer hardware; and
devirtualize the at least a portion of the computer hardware at runtime after the virtual machine monitor has been interposed at runtime, wherein devirtualizing the at least a portion of the computer hardware comprises stopping the virtual machine monitor such that the operating system resumes having direct control of the at least a portion of the computer hardware,
and loading of the operating system; and
wherein the operating system is to be booted in the computer before virtualizing the at least a portion of the computer hardware at runtime.

53. (Currently Amended) The article of claim 52, ~~wherein the computer hardware further includes a CPU, and~~ wherein the virtual machine monitor and the operating system each include CPU interrupt handlers; and wherein the software is executable to cause privileged instructions to trap to the virtual machine monitor, and to cause interrupts and traps to be redirected to the corresponding virtual machine monitor interrupt handlers instead of to the operating system interrupt handlers.

55. (Currently Amended) The article of claim 53, wherein the software is executable to cause ~~physical memory~~ access by the physical memory by the operating system to be disabled.

56. (Currently Amended) The article of claim 52, ~~wherein the computer hardware includes memory,~~ and wherein the virtual machine monitor is for causing a kernel module of the operating system to allocate a block of the physical memory, pin the block to prevent the operating system from using the block, and allocate the pinned block to the virtual machine monitor.

58. (Currently Amended) The article of claim 52, ~~wherein the computer hardware further includes an I/O device;~~ and wherein the software includes an operating system dual-mode driver to perform direct hardware control in a first mode and communicate with a corresponding device driver of a virtual machine monitor in a second mode; and wherein the dual-mode driver is set to the second mode when the at least the portion of the computer hardware is virtualized, and wherein I/O interrupts are redirected to interrupt handlers in the virtual machine monitor instead of interrupt handlers in the operating system.

59. (Currently Amended) The article of claim 52, ~~wherein the computer hardware further includes an I/O device;~~ and wherein the operating system includes a dual-mode driver to perform direct hardware control in a first mode and communicate with a device driver of the virtual machine monitor in a second mode; and wherein the dual-mode driver is set to the second mode when the at least the portion of the computer hardware is virtualized, and wherein I/O interrupts are redirected from interrupt handlers in the operating system to interrupt handlers in the virtual machine monitor.

60. (Currently Amended) The article of claim 52, ~~wherein the computer hardware further includes an I/O device; and~~ wherein the software is executable to cause I/O emulation of the I/O device to commence at runtime.

61. (Canceled)

62. (Canceled)

63. (Currently Amended) The article of claim ~~[[62]]~~ 52, ~~wherein the virtualized hardware includes a CPU; and~~ wherein the software causes the CPU to be devirtualized at runtime.

64. (Currently Amended) The article of claim 63, ~~wherein the virtualized hardware further includes memory; and wherein the memory is further encoded with the operating system including~~ includes first interrupt handlers; wherein the software includes second interrupt handlers; and wherein the software is executable to ~~cause~~ devirtualize by causing interrupts to be redirected to the corresponding first interrupt handlers instead of to the second interrupt handlers.

65. (Currently Amended) The article of claim 64, wherein the software is executable to ~~cause~~ devirtualize by causing a privilege level of the operating system to be restored from a lower privilege level to a higher privilege level.

66. (Currently Amended) The article of claim 64, wherein the software is executable to devirtualize by causing ~~cause physical memory~~ access of the physical memory by the operating system to be enabled.

67. (Currently Amended) The article of claim ~~[[62]]~~ 52, ~~wherein the virtualized hardware includes a memory, and~~ wherein the software is executable to cause the physical memory to be devirtualized at runtime.

68. (Currently Amended) The article of claim 67, wherein if a part of the physical memory was allocated from ~~[[an]]~~ the operating system to the virtual machine monitor prior to the runtime devirtualization, the software is executable to cause the allocated physical memory to be returned to the operating system as part of the runtime devirtualization.

69. (Currently Amended) The article of claim 67, wherein the software is executable to cause the physical memory to be remapped and wherein the software allows ~~[[an]]~~ the operating system to manage address translation with respect to the devirtualized physical memory.

70. (Currently Amended) The article of claim ~~[[62]]~~ 52, ~~wherein the virtualized hardware includes an I/O device, and~~ wherein the software is executable to cause the I/O device to be devirtualized at runtime.

71. (Currently Amended) The article of claim 70, ~~wherein the virtualized hardware further includes a memory, and wherein the memory is further encoded with the operating system including~~ includes dual-mode drivers that perform direct hardware control in a first mode and communicate with virtual device drivers in a second mode; and wherein the software is executable to ~~cause~~ devirtualize by causing the dual-mode drivers to be set to the first mode.

72. (Currently Amended) The article of claim 70, wherein the software is executable to ~~cause~~ devirtualize by causing emulation of the I/O device to cease at runtime.

73. (Canceled)

74. (Canceled)

-- END OF AMENDMENT --

Reasons for Allowance

10. The following is an Examiner's statement of reasons for allowance:

The cited prior art taken alone or in combination fail to teach, in combination with the other claimed limitations, "interposing the virtual machine monitor between the computer hardware and the operating system at runtime, wherein runtime includes a period of execution in the computer after booting and before shutdown of the computer, wherein the interposing occurs after booting of the computer, and wherein interposing the virtual machine monitor gives the

virtual machine monitor direct control of the at least a portion of the computer hardware such that the operating system no longer has direct control of the at least a portion of the computer hardware; and devirtualizing the at least a portion of the computer hardware at runtime after the virtual machine monitor has been interposed at runtime, wherein devirtualizing the at least a portion of the computer hardware comprises stopping the virtual machine monitor such that the operating system resumes having direct control of the at least a portion of the computer hardware” as recited in independent Claim 1; and further fail to teach, in combination with the other claimed limitations, similarly-worded limitations recited in independent Claims 31 and 52.

The closest cited prior art, US 6,961,941 (hereinafter “Nelson”), teaches an architecture that coordinates the use of system resources for different modules such as virtual machines. However, Nelson fails to teach “interposing the virtual machine monitor between the computer hardware and the operating system at runtime, wherein runtime includes a period of execution in the computer after booting and before shutdown of the computer, wherein the interposing occurs after booting of the computer, and wherein interposing the virtual machine monitor gives the virtual machine monitor direct control of the at least a portion of the computer hardware such that the operating system no longer has direct control of the at least a portion of the computer hardware; and devirtualizing the at least a portion of the computer hardware at runtime after the virtual machine monitor has been interposed at runtime, wherein devirtualizing the at least a portion of the computer hardware comprises stopping the virtual machine monitor such that the operating system resumes having direct control of the at least a portion of the computer hardware” as recited in independent Claim 1; and further fails to teach similarly-worded limitations recited in independent Claims 31 and 52.

Any comments considered necessary by Applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to Applicant's disclosure.

12. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Qing Chen whose telephone number is 571-270-1071. The Examiner can normally be reached on Monday through Thursday from 7:30 AM to 4:00 PM. The Examiner can also be reached on alternate Fridays.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Wei Zhen, can be reached on 571-272-3708. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the TC 2100 Group receptionist whose telephone number is 571-272-2100.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

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system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Q. C./

Examiner, Art Unit 2191

/Wei Y Zhen/

Supervisory Patent Examiner, Art Unit 2191